# General

## Guideline Title

ACR Appropriateness Criteria® headache — child.

## Bibliographic Source(s)

Hayes LL, Coley BD, Karmazyn B, Dempsey-Robertson ME, Dillman JR, Dory CE, Garber M, Keller MS, Kulkarni AV, Meyer JS, Milla SS, Myseros JS, Paidas C, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness CriteriaÂ® headache - child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 8 p. [41 references]

## Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Prince JS, Gunderman R, Coley BD, Blatt ER, Bulas D, Fordham L, Karmazyn BK, Podberesky DJ, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 6 p.

# Recommendations

## Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Headache — Child

Variant 1: Primary headache (chronic or recurrent headache including migraine without permanent neurologic signs or signs of increased intracranial pressure).

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| MRI head without contrast | 3 | | O |
| MRI head without and with contrast | 3 | | O |
| CT head without contrast | 2 | | |

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| CT head with contrast | 1 | | |
| | | | |
| CT head without and with contrast | 1 | | |
| CTA head with contrast | 1 | | |
| MRA head without contrast | 1 | | O |
| MRA head without and with contrast | 1 | | O |
| Arteriography cerebral | 1 | | |
| Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Headache with signs of increased intracranial pressure or positive neurological signs.

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| MRI head without contrast | 8 | If lesion is seen, perform a contrast-enhanced scan. | O |
| MRI head without and with contrast | 8 | Use contrast if appropriate based on noncontrast scan. See statement regarding contrast in the text below under "Anticipated Exceptions." | O |
| CT head without contrast | 7 | If MRI is not available. | |
| CT head with contrast | 5 | If MRI is not available. If noncontrast CT is positive and fever is present. | |
| MRA head without contrast | 5 | If vascular pathology is suspected based on CT or MRI. | O |
| MRA head without and with contrast | 5 | If vascular pathology is suspected based on CT or MRI. See statement regarding contrast in text under "Anticipated Exceptions." | O |
| CT head without and with contrast | 4 | If MRI is not available and if noncontrast CT shows abnormality | |

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| CTA head with contrast | 3 | Consider if SAH is seen on noncontrast CT. | |
| | | | |
| Arteriography cerebral | 2 | | |
| Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: High-intensity headache of abrupt onset (thunderclap headache) suggesting vascular rupture.

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|
| CT head without contrast | 9 | | |
| CTA head with contrast | 7 | If SAH is seen on noncontrast CT. | |
| Arteriography cerebral | 7 | If there is high clinical suspicion or a suspicious imaging finding. If local expertise is available. | |
| MRA head without contrast | 6 | Sensitivity relative to CTA is still uncertain. | O |
| MRA head without and with contrast | 6 | Sensitivity relative to CTA is still uncertain. See statement regarding contrast in the text below under "Anticipated Exceptions." | O |
| MRI head without contrast | 5 | Not a first-line test. Less sensitive than CT for SAH. | O |
| MRI head without and with contrast | 5 | Not a first-line test. Less sensitive than CT for SAH. See statement regarding contrast in the text under "Anticipated Exceptions." | O |
| CT head with contrast | 3 | | |
| CT head without and with contrast | 3 | | |
| Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate | | | *Relative Radiation Level |

| Radiologic Procedure | Rating | Comments | RRL* |
|---|---|---|---|

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Introduction

Headache is a common complaint, even in early childhood. The prevalence of headaches increases with age and ranges from 37% to 51% for children 7 years of age and gradually increases to 57% to 82% by 15 years of age. At the age of 16 years, more than 93% of all adolescents have already experienced at least one episode of fierce headache. Prepubertal boys are more affected with headache than girls, whereas after puberty, headaches are found more commonly in girls.

The evaluation of a child with headache begins with a thorough medical history and a physical examination with measurement of vital signs including blood pressure, a complete neurologic examination, and examination of the optic fundus. Diagnosis of primary headache disorders of children rests principally on clinical criteria as defined by the International Headache Society. Most children have primary headaches such as migraine or tension headaches, typically chronic or recurrent. Serious intracranial pathology is rare in these children. It is important to recognize that migraine headaches in young children may not meet the usual diagnostic criteria (e.g., they are usually of shorter duration than those of adults). Imaging in these patients shows a low rate (0.9%-1.2%) of significant findings.

Secondary headache is more common in young children. Potential underlying pathologies include brain tumors, meningitis, venous sinus thrombosis, arterial dissection, subarachnoid hemorrhage (SAH), and other disorders that may require prompt management. Brain tumors are rare in children, with an annual incidence approximates only three per 100,000 (0.003%) in children <15 years of age. The need to distinguish primary headaches from secondary headaches presents a major challenge.

There is lack of well-designed prospective studies evaluating diagnostic tests in children with headache. Most of the studies are retrospective case series, and some represent selective populations of children with headache. Therefore, it is difficult to assess the outcome of early detection of any intracranial pathology.

Primary Headache

According to the International Headache Society, primary headaches include migraine, tension-type headache, cluster headache, and other trigeminal autonomic cephalgias. Others include primary cough headache, primary exertional headache, primary headache associated with sexual activity, hypnic headache, primary thunderclap headache, hemicrania continua, and new daily-persistent headache.

*Migraine*

By 15 years of age, 3% to 10% of children experience migraine headaches. Most, but not all, studies report a female predominance. In 1988 the International Headache Society described two types of migraine: migraine with aura (classic), and migraine without aura (common). Migraine may have many manifestations. If there is a pattern to the headaches it is usually not difficult to diagnose. Children with migraines are symptom-free between headaches. If the child has typical migraine with or without aura, most clinicians would recommend no imaging studies. No imaging is also recommended in cases of common migraine of more than 6 months duration in patients with a family history of migraine and in nonprogressive migraine attacks. In ophthalmologic migraine with focal neurologic symptoms of unilateral ptosis or complete third-nerve palsy, imaging is recommended to exclude other intracranial abnormalities.

In patients with miscellaneous migraine findings or syndromes such as vertigo, basilar artery migraine syndrome, persistent confusion migraine syndrome, progressive chronic headache, or hemiplegic migraine, imaging may be appropriate to exclude an aneurysm, a space-occupying lesion, or other intracranial abnormality.

Because the presenting signs and symptoms of complicated migraines with focal neurologic findings cannot be discriminated from similar presentations related to intracranial neoplasms, imaging is recommended. In a study of 72 patients with brain tumor headaches, abnormal physical signs were present in 94%. It is important to note that seizures are one of the most common secondary etiologies for headache other than migraine and often have auras similar to some migraines. If seizures are suspected, magnetic resonance imaging (MRI) should be performed (see the National Guideline Clearinghouse [NGC] summary of ACR Appropriateness Criteria® seizures — child).

*Imaging*

The clinical experiences of primary care physicians, pediatricians, and neurologists indicate that neuroimaging studies have a limited role in children with primary headaches. The high prevalence of headaches and the low yield of imaging in pediatric patients presenting with headaches alone bring into question the value of screening for patients with primary headaches.

Secondary Headache

According to the International Headache Society, secondary headaches include those attributed to head and/or neck trauma, cranial or cervical vascular disorder, nonvascular intracranial disorder, a substance or its withdrawal, infection, a disorder of homeostasis, or psychiatric disorder. Secondary headaches or facial pain can also be related to disorders of the cranium, neck, eyes, ears, nose, sinuses, teeth, mouth or other facial or cranial structures.

*Headaches with Positive Neurologic Signs or Symptoms of Increased Intracranial Pressure*

Major studies addressing the issues of brain tumors and indications for imaging — including the data from 3,291 children described by the Childhood Brain Tumor Consortium, 315 children in the Boston Children's review, 245 children in Germany, and 72 children in the data of Honig and Charney — suggest that nearly all children with intracranial tumors have other symptoms or neurologic signs accompanying their headache. Symptoms depend on the location of the tumor and also on the age of the patients. Increased intracranial pressure leads to an increase of head circumference in the first year of life, which might prevent a rapid development of symptoms. The data from the Childhood Brain Tumor Consortium and the Honig and Charney study showed that 94% of children with brain tumors had abnormal neurologic findings at diagnosis and 60% had papilledema. Other neurological findings included gait disturbance, abnormal reflexes, cranial nerve findings, and altered sensation. Another study identified papilledema, nystagmus, and gait disturbances as univariant predictors of brain tumor. Confusion and other assorted abnormal neurological findings were multivariant predictors of brain tumors. These studies stress the need for a meticulous neurological and ophthalmological examination. It would appear appropriate from these retrospective data to consider intracranial imaging in any patient presenting with headache and positive neurologic findings.

*Imaging*

If there is concern for brain tumor, MRI of the brain with and without contrast is the study of choice. If MRI is not available, and/or there are difficulties with sedation, computed tomography (CT) of the head is indicated. CT without contrast can be performed initially; however a contrast-enhanced study is indicated if it is not possible to get a MRI scan of the brain.

Sudden Severe Headache (Thunderclap Headache)

Sudden severe headaches are more common in adults than in children. These "thunderclap headaches" are associated with subarachnoid and intracranial hemorrhage that may occur with aneurysms or arteriovenous malformations (AVMs). Nausea and vomiting are also seen in the majority. Although childhood intracranial aneurysms are rare, many case reports document severe acute headache as the presenting symptom. AVMs occur in one per 100,000 children per year and are four times more common than aneurysm in patients <15 years of age.

*Imaging*

Neuroimaging of children with severe or unusual head pain who have a first-degree relative with an aneurysm or AVM is indicated, as these vascular pathologies can be familial. Sudden severe unilateral headaches in the pediatric population and in young adults correlate with carotid or vertebral dissection, especially when associated with neurologic signs and symptoms (e.g., Horner's syndrome.) If there is strong concern for arterial dissection, the diagnosis is generally made by MRI or magnetic resonance angiography (MRA) and requires specific neck sequences (T1 fat-saturated and T2 fluid attenuated inversion recovery [FLAIR] axial images). CT angiography is also commonly employed for this indication (see the NGC summary of ACR Appropriateness Criteria® cerebrovascular disease). In sudden severe headaches, particularly in the absence of a family history of migraine, neuroimaging with a CT scan without contrast is recommended.

If subarachnoid or parenchymal hemorrhage is detected, further evaluation for aneurysm or vascular malformation must be performed. This can be accomplished by CT angiography (CTA), conventional angiography with digital subtraction angiography (DSA) techniques, or MRA. Whether to use CTA or DSA as the next study of choice has been and continues to be a topic of much debate. In 2007, one investigative group declared that since both negative and positive CTA scans mandate subsequent conventional angiography, the CTA should be dispensed with and patients should proceed directly to DSA. In 2008, another group of investigators replied that CTA is faster, safer, and cheaper (i.e., better) care. A 2011 meta-analysis concluded that multidetector CTA can be used as a primary examination tool in the diagnostic workup of patients with SAH. In the same journal issue, another author countered that conventional angiography with DSA is the ideal method for imaging these patients due to its ability to detect aneurysms quickly, reliably, and safely and that it guides the prompt proper therapy. What is clear is that DSA requires a skilled angiographer to be available emergently, and that if one is not available, CTA or possibly MRA should be performed in patients with acute SAH.

Headache Attributed to Infection

Headache can be attributed to either intracranial or extracranial infections. Intracranial infections include meningitis, encephalitis, and brain abscess. Extracranial infections include sinusitis, mastoiditis, and subdural empyema (SDE).

*Intracranial Infections*

Meningitis is inflammation of the meninges and is commonly viral or bacterial in nature. Symptoms in infants may be nonspecific, including fever, poor feeding, irritability, and lethargy. Seizures are not uncommon in these young children, mostly occurring when the inflammation has progressed to involve the brain parenchyma. Older children may have fever, headache, nausea, vomiting, confusion, stiff neck, and photophobia. Symptoms of viral meningitis can resemble those of the flu. Bacterial meningitis is a medical emergency that must be treated promptly to minimize the risk of serious complications, including death. Diagnosis is made by blood culture and lumbar puncture (LP). MRI or CT may be used in the acute setting to aid in diagnosis. CT is sometimes performed prior to LP to help determine if it is safe to perform the procedure. Neurologic signs and symptoms such as nuchal rigidity or alteration in consciousness may be indications for imaging.

There are known underlying disease processes that predispose patients to intracranial pathology. Children with underlying disease — such as immunocompromised patients, children with known neoplasms, sickle cell patients, children with collagen vascular disease, and patients with coagulopathy or hypertension — are predisposed to intracranial pathology. In high-risk groups, the presence of a severe headache may indicate significant intracranial pathology. It would seem appropriate to consider a lower threshold for imaging in this patient population.

*Extracranial Infections*

In many published reports, the overwhelming majority of acute headaches in children and adolescents were attributable to common, minor, transient conditions, such as upper respiratory illness.

Sinus disease may present with headache or may be associated with it. The diagnosis of acute sinusitis in children is made clinically; however, in children who present with severe and persistent headache as the dominant feature of sinusitis, imaging may be warranted (see the NGC summary of ACR Appropriateness Criteria® sinusitis — child.) Clinical signs suggesting intracranial abnormality include high fever, confusion, and change in mental status with and without focal signs. Headache is the most common symptom identified with the intracranial spread of infection resulting from dural irritation and localized encephalitis.

Epidural empyemas are collections of supportive fluid located between the skull and dura. In infants, SDE is most commonly a complication of purulent meningitis, while in older children the source of SDE is typically direct extension of sinusitis or otitis media into the extracranial spaces. The differential diagnosis includes meningitis, subdural and subarachnoid bleeding, and brain abscess.

*Imaging*

Imaging is decisive and aids treatment. CT and MRI have been the mainstays of imaging diagnosis of SDE. Contrast enhancement can increase the conspicuousness of a subtle collection. MRI is preferable for diagnosing epidural empyemas because of its ability to distinguish between different types of fluid, and the use of diffusion-weighted imaging is recommended to aid in the diagnosis and follow-up of children with suspected inflammatory subdural collections. Venous sinus thrombosis is another possible complication of sinusitis and mastoiditis, and if suspected, MR venography is considered the technique of choice for diagnosis and follow-up. In certain cases, MRI could be superior, as it shows the thrombus itself and not just the absence of signal as seen on MR venography. If MRI is not feasible or in cases in which the results of MRI are ambiguous, imaging with CT venography has been found to be a fast, widely accessible, and cost-effective alternative approach with high sensitivity and specificity in detecting venous sinus thrombosis.

Headache Attributed to Head and Neck Trauma

Clearly, intracranial imaging plays a critical role in the evaluation of the acutely injured patient; however, because headache is rarely a major indication for imaging, in the context of this Appropriateness Criteria® topic the Expert Panel will consider only the evaluation of headache related to subacute or remote trauma (see the NGC summary of ACR Appropriateness Criteria® head trauma).

Patients who have a history of subacute or remote trauma may present with headaches. Post-traumatic headache is defined as a headache that begins within 2 weeks of a closed head injury. A recent prospective study of children admitted with a closed head injury (minor 79%, major 21%) found that 7% of children reported chronic posttraumatic headaches, 4% had episodic tension-type headaches, and 2.5% had migraine without aura. Studies that correlate neurologic signs and symptoms with imaging findings in children with closed head injuries are lacking; however, studies of adults reveal that the complaint of headache has been associated with an increased risk of intracranial injury, even in patients suffering minor head trauma with Glasgow Coma Scores >13. Certainly it would be prudent to consider imaging of patients in whom neurologic signs or symptoms are positive, whose headaches are associated with vomiting, or whose headaches are increasing in frequency, duration, or severity, regardless of the severity of the initial trauma.

Summary

- Primary headache

    - No imaging is indicated for typical migraine.
    - In ophthalmologic migraine with focal neurologic symptoms of unilateral ptosis or complete third-nerve palsy, MRI is recommended.
    - MRI is also recommended for patients with miscellaneous findings such as vertigo, basilar artery migraine syndrome, persistent confusion migraine syndrome, progressive chronic headache, or hemiplegic migraine.
    - MRI should be performed for patients with seizures and postictal headaches.
- Secondary headache
    - If neurologic signs or symptoms of increased intracranial pressure are present, MRI is recommended. If MRI is not available or there are problems with sedation, CT should be performed.
    - CT of the head without intravenous contrast is recommended for sudden severe headaches (thunderclap headaches).
    - If subarachnoid hemorrhage is detected, CT or conventional angiography should be performed. MRA is also appropriate but is generally considered less sensitive in detecting small aneurysms.
    - If intracranial hemorrhage is present, MRI of the brain should be performed if possible. Obtaining a concomitant MRA is recommended.
    - If infarction is present, and there is concern for possible arterial dissection, CTA or conventional angiography should be performed. MRA is also appropriate; however, its sensitivity for detecting dissection is generally considered lower than that of CT or conventional angiography.
- Headache attributed to infection
    - If there is concern for meningitis or encephalitis, CT can be performed prior to LP to exclude impending herniation related to increased intracranial pressure.
    - MRI or CT may be appropriate to evaluate the brain, leptomeninges, and extra-axial spaces in patients with suspected meningitis, encephalitis, or brain abscess. MRI is the study of choice.
    - CT is usually appropriate for evaluating for sinusitis or mastoiditis.
    - CT or MRI is usually appropriate for imaging patients with SDE. If there is concern for venous sinus thrombosis, either CT or MR venography is usually appropriate.
- Headache attributed to trauma
    - If there are headaches with neurologic signs or symptoms following head trauma including vomiting, or headaches that are increasing in frequency, duration, or severity, CT is usually the initial imaging modality of choice in the acute clinical setting.
    - See the NGC summary of ACR Appropriateness Criteria® head trauma.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 $m^2$), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 $m^2$. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- SAH, subarachnoid hemorrhage

Relative Radiation Level Designations

| Relative Radiation Level* | Adult Effective Dose Estimate Range | Pediatric Effective Dose Estimate Range |
|---|---|---|
| O | 0 mSv | 0 mSv |
| | <0.1 mSv | <0.03 mSv |
| | | |

| Relative Radiation Level* | Adult Effective Dose Estimate Range | Pediatric Effective Dose Estimate Range |
| --- | --- | --- |
| 0 | 0.1-1 mSv | 0.03-0.3 mSv |
| 1 | 1-10 mSv | 0.3-3 mSv |
| 2 | 10-30 mSv | 3-10 mSv |
| 3 | 30-100 mSv | 10-30 mSv |
| *RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "Varies." | | |

## Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

# Scope

## Disease/Condition(s)

Headache in children, including:

- Primary headache (chronic or recurrent headache including migraine without permanent neurologic signs or signs of increased intracranial pressure)
- Headache with signs of increased intracranial pressure or positive neurological signs
- High-intensity headache of abrupt onset (thunderclap headache) suggesting vascular rupture

## Guideline Category

Diagnosis

Evaluation

## Clinical Specialty

Family Practice

Neurology

Pediatrics

Radiology

## Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

## Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for children with headache

## Target Population

Children with headache

## Interventions and Practices Considered

1. Computed tomography (CT) head
    - Without contrast
    - With contrast
    - Without and with contrast
2. CT angiography (CTA) head with contrast
3. Magnetic resonance imaging (MRI) head
    - Without contrast
    - Without and with contrast
4. Magnetic resonance angiography (MRA) head
    - Without contrast
    - Without and with contrast
5. Cerebral arteriography

## Major Outcomes Considered

Utility of radiologic examinations in differential diagnosis

# Methodology

## Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

## Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (eg, ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches.

1. Articles that have abstracts available and are concerned with humans.
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

## Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

## Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

## Rating Scheme for the Strength of the Evidence

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

## Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

## Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the ACR Appropriateness Criteria® Evidence Table Development document (see the "Availability of Companion Documents" field).

## Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

## Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

The appropriateness ratings for each of the procedures included in the Appropriateness Criteria topics are determined using a modified Delphi methodology. A series of surveys are conducted to elicit each panelist's expert interpretation of the evidence, based on the available data, regarding the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario. American College of Radiology (ACR) staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each

procedure. The surveys are completed by panelists without consulting other panelists. The ratings are a scale between 1 and 9, which is further divided into three categories: 1, 2, or 3 is defined as "usually not appropriate"; 4, 5, or 6 is defined as "may be appropriate"; and 7, 8, or 9 is defined as "usually appropriate." Each panel member assigns one rating for each procedure per survey round. The surveys are collected and the results are tabulated, de-identified and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. Consensus is defined as eighty percent (80%) agreement within a rating category. The final rating is determined by the median of all the ratings once consensus has been reached. Up to three rating rounds are conducted to achieve consensus.

If consensus is not reached, the panel is convened by conference call. The strengths and weaknesses of each imaging procedure that has not reached consensus are discussed and a final rating is proposed. If the panelists on the call agree, the rating is accepted as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached on the call or when the document is circulated, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

### Rating Scheme for the Strength of the Recommendations

Not applicable

### Cost Analysis

If magnetic resonance imaging (MRI) is not feasible or in cases in which the results of MRI are ambiguous, imaging with computed tomography (CT) venography has been found to be a fast, widely accessible, and cost-effective alternative approach with high sensitivity and specificity in detecting venous sinus thrombosis.

### Method of Guideline Validation

Internal Peer Review

### Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

## Evidence Supporting the Recommendations

### Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

## Benefits/Harms of Implementing the Guideline Recommendations

### Potential Benefits

Selection of appropriate radiologic imaging procedures for evaluation of children with headache

### Potential Harms

Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 $m^2$), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 $m^2$. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see the "Availability of Companion Documents" field).

# Qualifying Statements

## Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

# Implementation of the Guideline

## Description of Implementation Strategy

An implementation strategy was not provided.

# Institute of Medicine (IOM) National Healthcare Quality Report Categories

## IOM Care Need

Getting Better

Living with Illness

## IOM Domain

Effectiveness

# Identifying Information and Availability

## Bibliographic Source(s)

Hayes LL, Coley BD, Karmazyn B, Dempsey-Robertson ME, Dillman JR, Dory CE, Garber M, Keller MS, Kulkarni AV, Meyer JS, Milla SS, Myseros JS, Paidas C, Raske ME, Rigsby CK, Strouse PJ, Wootton-Gorges SL, Expert Panel on Pediatric Imaging. ACR Appropriateness CriteriaÂ® headache - child. [online publication]. Reston (VA): American College of Radiology (ACR); 2012. 8 p. [41 references]

## Adaptation

Not applicable: The guideline was not adapted from another source.

## Date Released

1999 (revised 2012)

## Guideline Developer(s)

American College of Radiology - Medical Specialty Society

## Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

## Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Pediatric Imaging

## Composition of Group That Authored the Guideline

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## Financial Disclosures/Conflicts of Interest

Not stated

## Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Prince JS, Gunderman R, Coley BD, Blatt ER, Bulas D, Fordham L, Karmazyn BK, Podberesky DJ, Paidas C, Rodriguez W, Expert Panel on Pediatric Imaging. ACR Appropriateness Criteria® headache--child. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 6 p.

## Guideline Availability

Electronic copies: Available from the American College of Radiology (ACR) Web site .

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900

## Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site .
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria®. Procedure information. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in PDF from the ACR Web site .
- ACR Appropriateness Criteria® headache — child. Evidence table. Reston (VA): American College of Radiology; 2012. 18 p. Electronic copies: Available from the ACR Web site .

## Patient Resources

None available

## NGC Status

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